

A Study on Economic Potential of Geothermal Heat Utilization using Input-Output Model

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1. Introduction and Objectives

Renewable energy such as solar, wind, hydro power and geothermal energy has currently attracted increasing attention as sustainable energy over fossil fuels which serve as major energy sources in Japan and elsewhere in the world. The fact that Japan depends on imported energy for 96% (IEA, 2011) of its supply often leads to concerns for energy supply instability due to the political uncertainty of exporting countries. Raising the energy self-sufficiency rate is a major challenge that we face today. Among above-listed renewable energies, promotion of developing geothermal energies is highly encouraged in Japan which has the geothermal resources of the third largest in the world. There have been discussions on the reasons that geothermal development has not been progressed and studies for individual heat utilization of hot springs; however, no studies have analyzed the geothermal heat utilization on industrial bases. This study aims to clarify the economic ripple effect of direct use of geothermal energy in Hokkaido and its feasibility based on the findings from the observation at Unterhaching geothermal power plant in Germany.

2. Methodology

This study focused on Hokkaido area which has the highest heat demand across the country. Firstly, within the target area, a simulation analysis was conducted in the case of construction of additional geothermal power plant with the same amount of output of one existing in the same region. It is preferable to use geothermal energy for direct heat utilizations instead of the power generation usages only. And yet, the heat supply businesses in Japan has not been progressed. The factors that prevent the diffusion of heat utilization in Japan were clarified through a comparison with the heat utilization system of Germany which makes progress in the use of district heating. Secondly, considering the direct heat utilizations, Input-Output analysis was carried out to verify the economic ripple effect of the heat use in different scenarios in Hokkaido area using Input-Output table of 53 divisions (Ministry of Economy, Trade and Industry, 2005). Finally, in order to increase the feasibility of scenario analysis, three regions in Hokkaido which have already started geothermal development were selected, of which the highest potential of geothermal heat utilization area was determined.

3. Discussion and Findings

1) Geothermal energy use by Input-Output model

In the case of construction of additional geothermal power plant with the same amount of output of the one existing in the same region of Hokkaido, the economic ripple effect revealed to be higher when the heat energy is directly supplied rather than when it was indirectly supplied as electricity. No changes were observed for agriculture and fisheries industries which were considered to have frequent usages of geothermal heat. On the other hand, there were positive effects on construction, real estate and transportation industries. Further heat utilization can be expected in these industries, e. g. , heating equipment for buildings and temperature control of cargo containers.

2) Feasibility study of geothermal heat utilization in Hokkaido

The result showed that the potential for geothermal heat utilization was the highest for the project of Shirasuisawa, among three regions of Shirasuisawa, Shibetsu-cho and Akai-mura. The main obstacles to geothermal utilization in this area were the high cost on infrastructure and the low heat demand resulting from the warmer climate of Japan compared to European countries. In many cases, the municipalities in Japan have little authority in the heat supply compared with Germany. Furthermore, the heat business entities are private in Japan. Since “Economic of scale” cannot be applied, the heat supply businesses are not able to compete in the market due to small scale of enterprises and industries. It is encouraged to promote deregulation in the field and increase of public funds which aimed to ensure the profitability of regional energy business in order to build the heat infrastructure and to establish competitive system in Japan.